SPARK

REPORT

STRATEGIC
PLANNING
FOR
APPLIED
RESEARCH
AND
KNOWLEDGE

Science
Council of
British
Columbia

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"CREATING THE FUTURE"
A STRATEGIC PLAN FOR THE ENVIRONMENT INDUSTRY OF B.C.

Prepared by
The Environment & Waste Management Committee
of the
Science Council of British Columbia

This report has been prepared by the SPARK Environment and Waste Management Committee and represents the views of the members of that Committee. While SPARK is an initiative of the Science Council of British Columbia, the views and recommendations expressed in the report are not necessarily those of SPARK, the members of the Steering Committee or the Science Council.

January 1991

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EXECUTIVE SUMMARY

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1.0 EXECUTIVE SUMMARY

The business opportunities resulting from public concern to protect and enhance their quality of life and to manage the environmental consequences of industrial development are being expressed in a growing B.C. environment industry. The industry is not fully developed and there is no clear focus as to the areas where B.C. will excel compared with our domestic and international competitors. It is within this context that the SPARK Environment Industry Committee has developed its best estimate of the necessary conditions required to stimulate and diversify this new sector.

The underlying conditions which form the basis for this report are that within B.C.:

- There is enormous public concern for solutions to a wide range of very serious environment problems.
- Enhancements to standards of living will require diversification from the present types of resource-based industry to more value-added, and technology intensive companies. Jobs in businesses working for environmental benefit are a very important subset of knowledge-based companies in general.

This Committee believes that appropriate actions on the part of government, the research community and industry can produce a thriving environment industry which can go a long way towards satisfying the major concerns noted above. The report reflects on constraints, identifies opportunities, outlines a general framework and makes recommendations applying to government, the research community and industry.

The Committee's stated Mission is:

> **"To develop a strategy and action plan to foster the B.C. environment industry with special reference to the application of technology and research."**

The 'environment industry' is difficult to define because it cuts across so many vertical industry sectors. The Committee adopted a broad description:

> **"The environment industry engages in activities and promotes technologies that have as their major intent monitoring and managing the natural environment, repairing the damage of pollution, capturing and retaining or neutralizing waste, preventing or reducing the generation of pollutants or harmful wastes, and increasing the efficiency of resource utilization."**

The industry therefore includes a broad range of products and services activities, including the design, manufacture, promotion, installation and maintenance of machinery and equipment, the provision of research, monitoring, consulting, legal and information services.

The Committee identified a number of generic impediments to growth common across B.C.'s knowledge-based industries. These barriers include limited early stage venture capital, underdeveloped management capability, lack of marketing expertise, weak infrastructure, and scarcity of good technical personnel.

The environment industry also has an uncertain market, confusing regulations, and a lack of research focus. On the positive side, the young industry faces a rapidly expanding market and is supported by a competent educational/research infrastructure.

However, unlike other industries which stand or fall on meeting price and quality standards in economically driven markets, government plays several critical roles in businesses with environmental emphasis. These derive from two inescapable duties:

- government as the collective arbiter of property common to all citizens.
- government as the collective protector of public health.

As a result of these responsibilities, government actions are viewed as an important factor influencing the success or failure of most businesses categorized as environmental industries. In turn, government action on environmental issues is largely stimulated by public pressure to toughen regulations and to police and penalize more effectively.

There is an opportunity for industry and government to work together to improve environmental and human health, in response to this public pressure in a number of distinct ways:

- By providing techniques of <u>measurement</u> and <u>analysis</u> which permit both the specific regulations and their enforcement.
- By providing new methods of <u>remediation</u> which can both induce government action and provide solutions to environmental challenges.
- By encouraging <u>alternative</u> processes or products which are designed to reduce or eliminate sources of pollution at the most cost-effective points (pollution prevention and waste minimization techniques/technologies).

- By encouraging effective planning, especially as it relates to the efficient and effective utilization of resources.

The evolution of environmental business in each of these categories is intimately bound to the regulatory process. This regulatory process which has been developed in response to public demands (and often with public consultations) intertwines industry with government action. It is within this context that the committee has focussed much of its attention on the role of government in this particular industry sector.

In conclusion, the strategic plan for the environment industry of B.C. reflects the current diversity of views to be expected at this stage in the evolution of the industry. The Committee identified seven key elements that must be dealt with if our industry is to be effective in developing for business success in the future. These are:

- We need clear and consistent **policy legislation and regulation** governing permissible levels of discharges to the environment, the handling of hazardous/toxic waste and resource utilization. The creation of innovative environmental technologies can stimulate the development of relevant rules and can also be driven by them.

- **Market incentives** are the preferred way to meet regulatory standards. Government should set regulations, but to encourage innovation it should not define how they are met.

- The use of **procurement policy** and the funding of **demonstration projects** can be powerful forces that encourage innovation within the B.C. environment industry.

- The environment industry is knowledge-based and will draw upon research and technological adaptations developed locally, nationally or internationally. It is therefore critical that systems are developed to ensure effective access to and transfer of enabling technologies. **Technology transfer**, coupled with greatly enhanced **work force training and education** are the key elements for success of the B.C. environment industry.

- For B.C. companies to compete effectively at the national and international levels, methods will need to be developed to build **alliances of environment companies**. Very few B.C. companies will be large enough to compete individually for major projects.

The Committee focused on five main themes for developing the strategy and related recommendations. These are: the market; legislation and regulation; science and technology; the work force; and finance.

"CREATING THE FUTURE"
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7 KEY ELEMENTS

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1.0 EXECUTIVE SUMMARY

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The Committee focused on five main themes for developing the strategy and related recommendations. These are: the market; legislation and regulation; science and technology; the work force; and finance.

2.0 INTRODUCTION

This report is a snapshot of an industry at a particular moment in a rapidly shifting landscape. It is inevitable that some images will be fuzzy, and some relationships will alter in the process of finalizing the report. The objectives of the report are:

- describe the present state of the environment industry in B.C.;
- indicate the prospects for development;
- outline the factors which may inhibit or encourage such development, and;
- delineate the contributions government, industry and the research community might make to enhance the economic welfare of the environment industry.

These objectives are outlined in the form of a strategic plan and represent the committee's best judgement of the necessary conditions required to stimulate the rapid and sustained growth of the industry.

Some material in this report (both in the body and appendices) is drawn from an earlier study commissioned by the committee and completed by the Institute for Research on Public Policy. This study was largely based on a review of existing material relevant to the mandate of the committee and on the results of interviews and correspondence with 70 persons involved in the environment industry, or knowledgeable of it by reason of an academic or government position, or involvement in an environmental group.

In examining the industry, the committee was struck by the similarity of many of the perceived barriers to development for the industry which were identified in other SPARK reports. These include such factors as limited early stage venture capital, lack of marketing and sales expertise, little or no infrastructure support, unwillingness to set up consortia for enhanced market penetration, and a general scarcity of good technical and management personnel. To the extent these generic conditions are dealt with by the creation of appropriate structures, institutions and/or programs, then it is the view of the committee that the environment industry will benefit.

Finally, we wish to note that although the outcome of a flourishing environment industry in the province will inevitably have a beneficial impact on progress toward the goals of enhanced environmental quality and sustainable development, these considerations are not central to the mandate of the committee. This statement notwithstanding, the committee offers in a

later section its view of a vision for the future for the province which includes reflections on the environment and quality of life.

2.1 THE SPARK MANDATE

The Strategic Planning for Applied Research and Knowledge Program (SPARK) is an initiative of the Science Council of B.C. The program aims to foster the diversification and enhancement of a wide range of economic sectors in the province through the effective application of research and technology.

The SPARK initiative was established in September of 1987 by the Science Council of B.C. with the support of the B.C. Ministry of Advanced Education, Training and Technology and the National Research Council. The process is interactive and bridges interests in government, the research community and industry. The program is sectorially based and is managed by a volunteer committee with representation from the three interests mentioned.

The Environment and Waste Management Planning committee was formed in early September, 1989. The committee is broadly representative with a current total membership of thirty (including government observers). The program provides the committee with the services of a full time facilitator who also acts as an industry champion. This position includes activities which directly support the development of the industry.

The names of committee members are noted below. Government members maintain observer status, however the committee wishes to sincerely acknowledge their significant contribution to the ongoing work of the committee. (Committee members noted by an asterisk were instrumental in the actual drafting of the report.):

Jamie Alley, B.C. Ministry of Environment and Parks
Earl Anthony, Conservation & Protection Br., Pacific & Yukon Region
Marilyn Baker, Mayor, District of North Vancouver
John Bennett, Bennett Environment Consultants Ltd.
*John Beveridge, Industry, Science & Technology Canada
Ross Brearley, Industry, Science and Technology Canada
*Michael Brown, Ventures West Technologies
Fred Claggett, Environment Canada
Alan Cornford, Simon Fraser University
John Davidson, Quanta Trace Laboratories Ltd.
*Bill Dinsmore, Powertech Labs Inc.
Tony Dorcey, Westwater Research Centre
*Laurence Evans, SPARK Environment Industry Champion
*Bob Everitt, Environment and Social Systems Analysts Ltd. (ESSA)
Don Ference, Don Ference & Associates

Otto Forgacs, MacMillan Bloedel Ltd.
*Peggy Frank, B.C. Ministry of Environment
Deborah George, Min. of Advanced Educ., Training and Technology
*Robert Grace, B.C. Ministry of Regional and Economic Development
Jackie Hamilton, B.C. Min. of Regional and Economic Development
Chris Hatfield, Hatfield Consultants Ltd.
*Robert Hawes, Norecol Environment Consultants Ltd.
*Don Herschmiller, H.A. Simons Ltd.
*Terry Howard, B.C. Research Corp.
Bruce Jenkins, Triton Environmental Consultants Ltd.
*Michael Jervis, Sierra-Misco Environment Inc.
Richard Lawrence, Coastech Research Inc.
*Monty Little, Syndel Laboratories Ltd.
David Marshall, GLOBE '92
Des Mullan, National Research Council
William Rees, UBC School of Community & Regional Planning
John Richardson, Canadian Waste Management Corporation
*Paul West, University of Victoria

The committee was co-chaired by Dr. Terry Howard, President, B.C. Research Corp. and Mr. Michael Brown, President, Ventures West Management Inc.

Consultant:

David Anderson, Institute for Research on Public Policy (IRPP)

2.2 MISSION STATEMENT

The committee's mission emphasizes the achievement of a vigorous and profitable environment industry in B.C. It characterizes its mandate to include the development of a set of actionable activities and processes which it considers important elements of a strategic plan. Finally, since it is largely made up of knowledge-based companies the statement includes reference to the application of technology and research.

MISSION STATEMENT

The mission of the Environment and Waste Management Sector Planning Committee is to develop a strategy and action plan to foster the B.C. Environment Industry, with special reference to the application of technology and research.

2.3 DEFINITION OF THE ENVIRONMENT INDUSTRY SECTOR

Defining the environment industry is a difficult task due to the diversity of activities carried out by the sector. The committee drew on a number of published definitions and then crafted its own version. The committee wishes to stress that although remedial processes and products will be important over the next five to ten years, ultimately it will be technologies which incorporate environmental considerations at the beginning of the design process (pollution prevention - clean technologies) which will have the most impact in the long run. This concept has significant ramifications for longer range planning, especially in education and training of engineers and industrial designers.

ENVIRONMENT INDUSTRY DEFINITION

The Environment Industry engages in activities and promotes technologies that have as their major intent, monitoring and managing the natural environment; repairing the damage of pollution; capturing and retaining/neutralizing waste; preventing or reducing the generation of pollutants or harmful wastes; and increasing the efficiency of resource utilization. The industry includes a broad range of activities, including the design, manufacture, promotion, installation and maintenance of machinery and equipment, and the provision of research, monitoring, consulting, legal and information services.

2.4 A VISION OF THE FUTURE

There is a growing need to create a vision of the future for Canada and the province of British Columbia. The committee has reflected on the public's perception of the crucial importance of maintaining a healthy and productive environment, not only as a method of ensuring our own well-being but as an end in itself. It is with this thought that the committee has chosen to make a statement which reflects the concept of sustainable development and places it in the context of a vision for the future:

Where every Canadian can enjoy the maximum opportunities provided by a well-managed society for personal freedom, happiness, prosperity, and achievement.

Where the country benefits from good stewardship and housekeeping, such that the natural endowments of the land are enhanced rather than depleted.

Where the legacy passed on to future generations of young Canadians is brighter and better than that passed to this generation.

Clearly, the protection and proper management of our environment through programs aimed at developing environmental awareness and putting in place institutional structures which foster sustainable development are overwhelmingly important in achieving the vision.

The environment industry can be part of the solution to achieving this vision and thus serves a dual purpose by enhancing the economic welfare through profitable business development and also by assisting in the resolution of environmental challenges which threaten our very existence on the planet.

3.0 BACKGROUND INFORMATION

3.1 ENVIRONMENTAL CHALLENGES: OPPORTUNITY OR PROBLEM?

The threat to the global environment and ecosystems brought about by man's economic activities, and the resurgence of this issue to the top of the public agenda (particularly since the publication of *Our Common Future* by the United Nations World Commission of Environment and Development) provide notice to both business and government of the urgent need for action.

To effectively address environmental issues such as global warming and sustainable resource management, stronger research efforts are required in the critical fields of energy efficiency, renewable energy resources, waste management, and in developing sustainable systems of production. Investment in research and development, coupled with the provision of the requisite human resources are the key factors needed to prevent continued environmental degradation.

Conversely, dealing with these environmental challenges will clearly present economic opportunities for suppliers of equipment, technology and services. This in turn calls for action to enable the existing environmental industry and future entrants to seize commercial opportunities as they arise in a domestic and international context. Converting the potential of leading edge science and technology into commercial realities calls for an infrastructure of government policies and business initiatives that are complementary and coordinated.

Many initiatives undertaken by government, business and the academic/research community have already been undertaken to support the development and growth of the environmental industry. (See Appendix 1.) Although the plethora of activity requires increased coordination, it may also be possible that the synergy it has created has helped propel the provincial environment industry forward more quickly than might otherwise have been the case.

Since defining the environment industry is problematic, it may be more important to identify the problems this industry sector attempts to address. Some environmental problems are clearly defined. Municipal solid wastes and sewage, for example, have been with us since early times and various technologies have been developed to deal with them. However, in other environmental fields there are many areas where knowledge is limited. While the 'greenhouse effect' and the problems of the ozone layer have received a great deal of attention, there are still many unanswered questions. Some toxic chemicals (such as chlorinated dioxins) have received considerable study, while the effects of others have been examined in much less detail.

Environmental and resource inventories for British Columbia and much of the rest of the world are incomplete.

This uncertainty, both at the level of knowledge of the physical environment and its problems, and the related uncertainty associated with the adoption of environmental policies, has a fundamental impact on the environmental industry. The nature of the demand on the industry inevitably will be unclear when the information on the problems that the industry must address is itself unclear. Government policies, when implemented can have a profound long term impact on the form and function of the environment industry. For example, the so called 'command and control' policies adopted by the U.S. Environmental Protection Agency (EPA) in the early '70's has been instrumental in shaping the American environment industry. This has resulted in substantial bureaucratic and industry inertia which tends to preclude movement toward a new orientation relating to the use of economic/social incentives and pollution prevention (clean technologies). EPA is currently attempting to initiate pollution prevention strategies and it would be useful for Canada to work in concert with the agency to ensure both economies move forward in concert.

Despite such uncertainties, there is no doubt the problems of environmental degradation have seized the public consciousness and demand a visible political, as well as industrial response. There is also no doubt the public interest in attempting to arrive at an effective reconciliation of development goals with environmental objectives, inevitably will affect investment and management decisions for the foreseeable future. The challenge to the entire organization of economic activity is clear even though its extent and shape is still blurred.

3.2 A PLEA FOR MORE INFORMATION

Although there have been a number of studies on the environmental industry in British Columbia in recent years, there appears to be no comprehensive overview. This is in part because of the difficulty of establishing a clear definition of the industry, and in part the result of the rapid growth of the sector. Statistics on the number of firms in the industry and their activities quickly become out of date. This is an indicator of the state of environmental reporting in general. While there is a recognized need to collect data on the physical and biological resources of the province and to carry out monitoring of environmental quality, this increased interest in data collection has yet to extend to systematic data capture and information on the industry itself.

One exception to the foregoing is the study commissioned by the Asia Pacific Initiative (March 1988) which produced an environment industry company directory/data base and an assessment of the export market capabilities of the

B.C. industry. While the study was a first attempt at quantifying the industry it suffers from a number of deficiencies. Although it is badly out of date, it is worth reiterating the key statistics documented in the report:

> **Estimates generated in 1987 indicated there were over 400 companies which provided environmental services and products. An estimated 175 companies drew the majority of their income from such activities. (Note: The study did not distinguish between large firms for which environmental products/services represented a small portion of annual revenues/personnel, but were significantly larger than a small firm whose sole activity was in the environmental arena.)**
>
> **The consultants estimated the annual sales for the B.C. environment industry to be $114.4 million, including exports of $67.6 million.**
>
> **Estimates of employment suggested 4,600 people employed by environmental companies, with 1,100 employed full time.**
>
> **The main export markets were the United States and the Asia Pacific region, accounting for 46% and 37% respectively.**

These data are presented only because there does not appear to be a more recent evaluation. This points to the need to inventory the industry on a regular basis and for the data to be placed in an easily accessible data base which can be shared over a wide area. To place the need for regular updates in perspective, observed annual growth rates in the environment industry are in the range of 25-40%.

A number of other studies of the industry are currently underway, including work initiated by the western Ministers of Environment, and Science and Technology, and a number of consulting firms. These studies, along with the *Environmental Industries Sector Studies* planned by Industry, Science and Technology Canada, will add to the available information on the industry. They will also assist in developing an understanding of the size and importance of this sector within the B.C. economy and how it relates to the industry in other provinces.

Other reports identified in the study prepared by the Institute for Research on Public Policy (IRPP) to which the reader may wish to refer, include:

- the ACS Group Study entitled *Critical Science and Technologies For Canada's Environmental Industries: Exploratory Studies*, June 1989

- the Institute for Research on Public Policy study entitled *Defining the Environmental Protection Industry*, March 1987

- the study of the Economic Development Commission of Greater Victoria, entitled *Environmental Enterprise*, July 1989

- the report of G.E. Bridges Associates for the Ministry of Regional and Economic Development entitled *A Summary of Business-Oriented Environmental Industry Activities in British Columbia*, January 1990. (A list of additional studies is cited in this report.)

A recent report by Mr. Ken Stratford, of the Economic Development Commission of Greater Victoria emphasizes the need for a comprehensive data base of such information, with the object of better marketing of the services that the industry in this Province can provide. It is expected the newly formed Canadian Environment Industry Association will also be involved in data collection of this type. Finally, the Ministry of Regional and Economic Development is engaged with the other Western Provinces in developing a more extensive study of environmental business, and the British Columbia Trade Development Corporation, together with the Ministry of International Business and Immigration, is compiling a British Columbia environment industry company directory.

3.3 GOVERNMENT POLICY: A CRITICAL FACTOR

As mentioned, the committee discovered many similarities between the environment industry and other advanced technology sectors. A key distinguishing characteristic of the environment industry however, is that it is almost completely driven by government policy, regulation and legislation.

It is critical to the well-being of the industry that governments at all levels understand that environmental policies and regulations have a profound effect on the environment industry. Policies which are clear, consistent and staged over time, will produce economic benefits for the environmental industry.

As an example, consider the air quality policies instituted by California's South Coast Air Quality Management District which has been set up to manage the Los Angeles Basin air shed. Policies are dramatic and staged with targets stretching out for up to fifteen years. This has the effect of giving both the businesses challenged by the policies and the environment industry which benefits from them, sufficient lead time to manage their businesses effectively. A secondary benefit of such policies for the environment industry is that they serve as a kind of covert, *no-cost* marketing tool in that those in need of specific products and services are likely to search for them in the region

impacted by the policies. What is useful to note from the Los Angeles experience is that environmental goals/targets were delineated first, then institutional facilitative structures were implemented (such as the Technology Advancement Office - research & technology transfer institute) and finally, rules and incentives were developed which helped to more precisely define how everyone is expected to behave.

Contrast this to the straight 'command and control' method referenced earlier which attempts to manage behavioural change through ever more complex and stringent regulations. This strategy has had the unfortunate side effect of encouraging an adversarial environment in which more time is spent in court than in handling the problem. **This is not to say there is no role for rules and regulations, just that a sophisticated blend of rules, incentives and enabling infrastructure will likely produce better and faster results.**

At present, the translation of the environmental interest of the public into specific federal and provincial policies is proceeding slowly and unevenly. There are a number of reasons for this. Worth noting is the 1984/85 decision of the federal government to partly withdraw and leave more environmental regulation to the provinces. In the face of adverse public reaction this decision has been reversed but it remains to be seen whether the federal government's Green Plan will reduce the uncertainty that currently exists.

Uncertainty is also evident at the provincial level in B.C. While schedules or target dates have been announced in a number of environmental areas, the overall impression is still one in which goals and policies are not sufficiently clear. This makes purchasers of products and services of the environmental industry in B.C. uncomfortable about embarking on substantial environmental expenditures until they are more certain of future requirements.

The uncertainty about provincial government intentions is exacerbated by its treatment of B.C. environmental impact studies. In recent years there have been many such studies, and a great deal of environmental monitoring and other scientific work has taken place as a result. However, in many cases this has not led to clear operating guidelines. The commitments made during the process have frequently not been adhered to by proponent companies, and rarely have serious consequences resulted. This situation appears to be changing, however the extent of the shift and the future expectations of government are not entirely clear. Industry's uncertainty in this regard appears justified.

3.4 MARKET INCENTIVES MAY BE THE ANSWER

Despite the previous discussion of the importance of clear environmental laws and regulations, it is important to note that reliance on legislation may not be

the appropriate method of achieving environmental goals. Once these goals are determined (for example, the level of emissions deemed acceptable), the use of the market and market incentives is probably a more efficient way of achieving those goals than are the traditional effluent standards or permits. Further, market mechanisms may result in more sophisticated and precise control without the extensive data collection which is necessary for the more familiar regulatory approach.

Support for the use of market forces is developing quickly, especially in the United States and in the European Community. As recently as a decade ago environmental regulators and citizens' environmental groups were prone to regard the market system as an obstacle to achieving environmental quality goals. Today, the more thoughtful regulators and environmental movement leaders realize the power of the market can be utilized to achieve the objectives they seek. They have also realized that placing higher than necessary environmental control costs on industry ultimately reduces the resources available to improve the level of environmental quality, at the same time weakening the competitive position of the industry concerned. This ultimately weakens the political will to establish high environmental standards. Cost effectiveness is becoming recognized as a potentially critical instrument in pursuit of environmentally-desirable goals.

There are now two decades of experience with emissions trading and emissions charges in both Europe and in North America. The 1989 amendments of the U.S. administration to the U.S. Clean Air Act, 1955, feature many of these economic incentive measures, as do recent American initiatives with respect to water quality and acid rain. The Bush administration has adopted the market approach with enthusiasm. The savings are considerable. Using market mechanisms in the battle against acid rain can be expected to save some billions of dollars in the U.S. alone.

The importance of the choice of means to achieve environmental quality is not simply a question of economic efficiency. Unlike mandated best available technology, the market approach encourages innovation and development. There is a strong economic incentive to develop and install more efficient technology. Suppliers and other companies in the environmental industry are thus more likely to be more aware of and involved in developing new technology.

In Canada the recognition of the importance of economic incentives in achieving environmental quality is spreading. Nevertheless, we currently lag behind the U.S. and Europe. As the recognition of the value of such incentives increases, there will be further change to federal and provincial governments' approaches to achieving environmental quality. In the meantime however, the uncertainty regarding what measures will be adopted to ensure

environment quality exacerbates the problem of concern over goals. Not only are the objectives often unclear, but the means of achieving them are similarly uncertain.

From the point of view of British Columbia's environmental industry and its clients, such uncertainty and delay is a serious constraint on development. From the industry's point of view, a clear division of responsibility between the two levels of government, clear development of environmental objectives, and maximum flexibility for industry in achieving those government established goals, would be highly desirable developments.

Respondents to the committee's survey also mentioned timing of government measures. Some industry members believe that British Columbia should be at the forefront, or even ahead of other jurisdictions in the setting of standards, in order to force development of new technologies. Others, particularly in the resource-based industries who have good reason to believe their companies would ultimately suffer the costs for such developmental activity, are far more cautious. Better, they say, for British Columbia to be a year or two behind Ontario, and perhaps five years behind the leading United States jurisdictions. This way, it is argued, successful technologies can be transferred and adapted with minimal cost with only a few failures. Conversely, one ramification of this approach is that Canada might anticipate that more 'green' countries would use economic sanctions against Canadian firms' products, arguing that environmental practices/regulations should be fairly applied across the board to ensure a level playing field in international markets.

3.5 THE NEED FOR BETTER DECISION MAKING PROCESSES

The uncertainty over government environmental plans and intentions has had a number of unfortunate effects. Without the framework provided by a government regulatory system designed and recognized as protecting the public interest and the environment, public opinion on environmental issues becomes unfocussed.

Popular environmental issues are in many cases not the most important. However in the absence of a clear agenda of their own, governments too often see their role as responding to such public pressure, and judge their success by the speed with which they manage to respond. Resource industries complain that it is not possible to effectively plan for environmental protection in an orderly way when the future is so unclear. In turn, companies within the environmental industry serving the resource industries are less able to develop long term strategies for growth.

A minority of those surveyed in the industry regard this environmental activism and the public's suspicion of government as a beneficial

development. In their opinion, the substantial pressure exerted on government by such groups will result in a greater environmental concern at the political level, and thus greater environmental action in the jurisdiction involved. The majority are far less sure of the merits of the present climate of environmental debate.

On environmental issues, the interest of the public tends to wax and wane depending on what is presented by the media. Furthermore, the environmentally conscious public has a difficult time understanding risk and risk statistics. The issues are often complex and multi-factoral which makes it difficult even for experts to understand how environmental systems work. This fact, coupled with the often arcane way in which environmental risks are presented means the public is often not in a strong position to evaluate effective strategies to solve complex environmental problems. A better approach to environmental decision-making is required which couples good, independent, expert advice which is easily understandable by the various stakeholders. The achievement of this goal should lead to better decisions and less confrontation.

The recently initiated round table process and the new consultative mechanisms in specific resource areas such as forestry, can be expected over time to improve the situation. Consultative mechanisms in themselves however, do not necessarily result in agreement. To some participants they are simply a forum for further advocacy. In the absence of an objective source of fact and opinion, there will still remain a problem despite the new consultative mechanisms.

3.6 NEED FOR DEMONSTRATION OF PRODUCTS, SERVICES

There is an issue which many in the industry feel is of major importance to the future well-being of the sector. This is the perceived need to demonstrate products, services and technologies in real world situations in order to gain valuable experience, exposure and to provide the background necessary to market their products internationally. It is a common complaint that government and resource industry users have not bought local environmental technologies. This points to the need for government to lead the way by directed procurement programs and to set up industry demonstration projects where government funding is applied to solve environmental problems. Clearly, if as the Green Plan consultation document suggests, the federal government is serious about 'getting its own house in order' then a policy which recognizes and uses Canadian environmental technologies could serve as a powerful lever for economic development.

Large scale demonstration by governments can be used to overcome situations where the implementation of new environmentally benign technologies is

thwarted by the existence of complex infrastructure and system inertia. The internal combustion engine which powers our automobiles is the most used example. Many observers argue that because government is the single largest 'business' in a country, it has enormous leverage to shift the system to a new steady state. (See appendix 2 for a recent speech by Barry Commoner on this topic.) It is the view of the committee that governments should explore and implement policies which effect market shifts for new environmentally benign technologies, especially for situations where it is unlikely that normal market forces will provide the desired result.

3.7 SOME EMERGING ISSUES AND OPPORTUNITIES

3.7.1 Environmental Education and Training

In the United States there is a flourishing environmental training sector which provides courses and workshops on how to comply with EPA regulations, the impact of new environmental policies, training of company personnel in the handling of toxic and hazardous wastes, etc. As an indication of the size of this activity in the United States, the National Environmental Training Association represents over 1000 members. Very few Canadian companies appear to have grasped this potential opportunity. With the implementation of the federal government's 'Green Plan', the proposed Federal Environmental Assessment Review Act and provincial regulations, the committee feels there will be a substantial need for companies to be fully apprised of the new environmental regulations, policies and programs. It is the committee's view such training not only represents a significant business opportunity, but also will provide companies (especially in the resource sector) with a valuable service to ensure they have the most up to date environmental information with which to manage their affairs.

3.7.2 Environmental Health and the Environment Industry

The impact of environmental contaminants and toxins on public health represents a significant challenge for the research community in Canada. Although funding has been provided to researchers to conduct inquiries in this area, to date government agencies have not specifically targetted environmental health for program funding. One exception is the Great Lakes Program which has allotted funds to look at the impacts of pollutants in the Great Lakes ecosystem on public health.

Environmental health impacts research is a crucial element in the setting of effective rules and regulations on the discharge of materials into the environment. At present many observers believe that legislation is being driven by factors other than sound scientific evidence.

For example, the public's perception and assessment of risk due to environmental contaminants appears to be largely driven by popular media accounts which in many cases are not founded on sound scientific evidence. There is a need to not only conduct environmental health research, but to identify effective means to attribute risk and more importantly to generate effective mechanisms for communicating those risks to the public. Such research and communication strategies would inevitably lead to more effective decision making by the public and policy makers.

There are at least two potential benefits to the environment industry from enhanced and targetted environmental health research. First, the environment industry could assist in the development of diagnostic, measurement and monitoring procedures/equipment which would provide requisite information about environmental health impacts. Second, the development of rules and regulations based on sound scientific evidence would lead to more rational decision making, which would allow for more stable and longer term environmental planning. The latter factor would provide a stable planning path for the environment industry to begin to develop long range strategies for technology development.

3.8 SUMMARY

In summary, the environment industry is constrained by factors which have been identified for many advanced technology sectors in B.C. These include a lack of adequate management expertise, inexperience in marketing and sales, inadequate or non-existent early stage financing, few talented technical people and an inability to access mature distribution channels.

A range of external factors impact on the sector which are largely unique to the industry, and these relate to the fact the industry is mainly driven by government policy, regulation and legislation. These include a lack of clear jurisdiction between levels of government, the seeming inability of governments to set clear, long-range policies and rules, a confrontational atmosphere which stymies cooperative problem solving, and the lack of a clear set of environmental priorities based on sound scientific evidence rather than representation in the media.

Finally, the industry has few opportunities to demonstrate their technologies under conditions which would allow them to improve their products and use the experience to penetrate international markets.

4.0 SITUATION ASSESSMENT

As part of its assessment of the industry the committee evaluated the Strengths, Weaknesses, Opportunities and Threats (SWOT Analysis) of the environment industry in B.C. These items formed the input material for strategies, which in turn stimulated the identification of appropriate actions. These items are included here since they form the basis for much that follows.

4.1 STRENGTHS

• Existing infrastructure

Some parts of the environmental industry already possess the necessary critical mass to fuel further development.

The Province already has a strong resource sector with large and visible environmental problems which require services and products. Many of B.C.'s resource sector service firms already possess linkages into the international market.

B.C. has existing strengths related to the environment industry which it can pursue. For example, we have a strong technical information sector as well as expertise in biotechnology, marine and subsea technology, aquatic monitoring and pollution control.

• Expanding market

The domestic and international market for environmental products and services is strong and growing. The U.S. West Coast can be considered as an extended domestic market for B.C. technology.

As well, there is a growing political will towards environmental legislation.

• Educational/research infrastructure

The Province has a well established educational/training infrastructure which can provide the needed human resources. The Ministry of Advanced Education, Training and Technology's Science and Technology Fund ($420 million over five years) is a welcome program which will undoubtedly go a long way to enhance this infrastructure.

Institutions in the region have already begun to develop expertise in environmental sciences and environmental law.

As well, B.C.'s three major universities have excellent capabilities in science and technology with a number of world class scientists on staff. These institutions produce excellent graduates in science and technology.

B.C. also has strong research capabilities outside of the universities, including several major research organizations, e.g. PAPRICAN, FORINTEK, FERIC, B.C. Research, Powertech Labs, etc.

- **International reputation**

B.C. has a diverse and relatively unpolluted ecosystem which can exist as an attractive model for international clients. This could serve to reinforce the already strong international belief in the technical capabilities and expertise of B.C. (and Canadian) scientists and engineers.

Quality of life factors are a strong influence in attracting environmental companies and people to locate in B.C. A number of talented individuals from other parts of the world have already moved to the province.

Using its international reputation and expertise, B.C could establish centres of environmental excellence in developing countries. We could also acquire research and technology from abroad.

4.2 WEAKNESSES

- **Market uncertainty**

There is a relatively small waste management market which is subject to domination by large suppliers from outside the Province.

The domestic market is influenced by political uncertainty and the unproven staying power of the current environmental awareness.

- **Lack of marketing sophistication**

In B.C. there is a general lack of sophisticated or mature marketing expertise. We tend to develop order-takers rather than aggressive sales people. The situation is not likely to improve quickly -- unlike our neighbours to the south, we have no private institutions through which to develop marketing expertise. So our graduates, while technically skilled, tend to lack skills in dealing with real-world business issues such as marketing and distribution.

The root of the problem starts with our approach to research -- compared to other countries, little of our research is market-driven. Instead, most research is driven by governments and universities. There is no substantial linkage

between market needs and areas of technology research. One barrier to solving this problem is the very strong lobby group of academics and scientists who are committed to research driven by scientific curiosity.

Once marketable technologies are developed they are still difficult to commercialize because of our excessive concern over sole ownership of intellectual property rights. There is restricting and conflicting ownership of patents by professors within B.C.'s university system.

As well, too often we sell our research results as simple know-how, rather than embodying our knowledge in a product or process.

Our companies often lack specific market intelligence relative to export opportunities. To make matters worse we have very weak channels of distribution and therefore slow response/feedback to guide R&D.

- **Confusing regulations, enforcement**

In Canada, there is a lack of consensus between the two levels of government which has resulted in a partial paralysis of the market and the industry.

There is a history of lax enforcement and an unproven capacity for the population to "pay," which creates risk and uncertainty.

These problems are not limited to Canada, however. Regulatory standards will be complex and will vary from country to country. This could limit market penetration by small companies.

- **Lack of research focus, cooperation**

Our knowledge base is diffuse resulting in a general lack of focus -- including a need for concentration on key areas in environmental research and technical development. Part of the problem is there is still a great deal of confusion over what is environmental science.

As well, in B.C. we are limited in the environmental research areas upon which we can focus because we lack the critical mass of expertise to develop technology in many areas.

There is a general lack of university, industry, and government interaction in R&D. We currently have no effective mechanism to transfer technology from universities to industry and among firms.

The strong presence of multi-national ownership in resource sectors limits resolve to perform R&D.

• **Lack of financing for research companies**

With the exception of the recently announced provincial Science and Technology Fund, there is little ongoing financial commitment by government and by private companies to develop science and technology expertise. The Sustainable Environment Fund provides funding to protect and enhance the environment, however the manner in which it is being applied is unclear at this juncture. Regarding industry, with the exception of one firm, our substantial forest industry sector is a gross under-performer in the R&D area in general, and environmental R&D in particular. The industry applauds the recent announcement of the five year Science and Technology Fund and looks forward to working with government to ensure the environment industry's objectives are considered in the execution of the program. The committee also extends an invitation to the Ministry of Environment to actively participate in the implementation of the Sustainable Environment Fund.

Observers have identified the lack of R&D expenditures as a national problem. Compared with other countries, Canada spends a very small percentage of its GNP on R&D. B.C.'s R&D performance reflects the national norm, however the new S&T Fund will help to alleviate this imbalance.

Because most of the B.C. companies are small, their own financial resources are inadequate to support prolonged R&D and yet they have few other choices. Both public and private capital for environmental R&D is scarce and difficult for small companies to obtain.

• **Outside competition is threatening**

B.C. is not the only jurisdiction to recognize the growing opportunities in the environment sector. There is strong competition from very large international firms. Many of these firms have established distribution channels and presence.

The B.C. environment sector may be at an inherent disadvantage because some other countries have lower production costs as well as access to cheaper financing.

Much of our failure to measure up to the competition relates to the weaknesses listed above. To cite two examples: our propensity to sell technology and "know-how" will limit sales in the long term; and other countries have a better linkage between R&D and the manufacturing processes.

• **Trained people being lured away**

The US, Japanese and Europeans are actively pursuing student exchange programs. As well, they are aggressively providing training programs in developing countries.

There is a constant flow of expertise towards challenging opportunities and if we fail to develop these here, the expertise will leave, lured to other areas by better opportunities. The countries mentioned above are taking aggressive steps to provide those opportunities.

5.0 THE STRATEGY

The committee developed its strategy based on a broad range of critical assumptions about the environment industry and relevant factors impacting on it. There are five main themes:

- The Market
- Legislation and Regulation
- Science and Technology
- The Work Force
- Finance

5.1 THE MARKET, DOMESTIC AND INTERNATIONAL

5.1.1 Marketing Objectives

- To support the development within British Columbia of a knowledge-based environmental industry consisting of internationally-recognized companies that have a competitive advantage based on their service of domestic needs, and with the growth potential to generate annual revenues of one billion dollars within five years.

- To facilitate the development of strategic alliances, joint ventures and consortia which will provide for the identification and use of pertinent technology, marketing and management skills, and also the sharing of facilities and distribution networks.

- To ensure the development of a strong domestic market for B.C. environmental technology companies.

5.1.2 Strategy & Action Plan Recommendations

Strategy 1:

> *The implementation of a joint industry and government advertising campaign to promote B.C. competence to the public and to potential buyers.*

Recommendation:

The Ministry of Environment and the Ministry of Regional and Economic Development should jointly implement a comprehensive information program to link environmental problems with the availability of B.C. expertise in finding solutions. The Ministry of International Business and Immigration, and the B.C. Trade Corporation should be consulted on this project as well. Existing resource-based industry should be encouraged to look for assistance in

solving environmental problems in the local knowledge-based industry sectors. The public should be encouraged to support the role of science in our schools, universities and in industry.

Rationale:

The development of a science and technology culture coupled with increased public awareness of the real environmental issues and solutions are important factors in establishing a thriving environment industry in B.C. The Ministry of Advanced Education, Training and Technology has a new science and technology awareness program. The Ministry of Environment also has a new public education program. The committee supports these endeavors and wishes to assist in their implementation.

Strategy 2:

> *The establishment of a pro-active matching process and/or agency that matches sellers and buyers, preferably through an industry association.*

Recommendation:

Environmental-related knowledge-based industry associations should be given substantial financial support so they can provide meaningful assistance to the environmental industry in finding customers within the domestic market.

The resource industry sector should be encouraged to be more pro-active in seeking and supporting local knowledge-based companies who are endeavoring to provide solutions to environmental problems.

Rationale:

Users of environmental products and solutions should be encouraged to use local suppliers wherever possible. This will serve to build a competitive domestic environment industry which will benefit both buyers and sellers of the services and/or products. The B.C. Purchasing Commission has an Environmental Purchasing Policy (April 1989) which states: "The Purchasing Commission will support the market for recycled and environmentally sensitive products by increasing both supply and demand, where practical and effective, and by encouraging economic growth and development in recycling and related industries". This is a positive step, however many companies are not aware of the program and it would be useful to raise the level of awareness of B.C. environmental companies through more effective advertising. To the knowledge of the committee no similar program exists at the federal level.

Strategy 3:

> *The provision of low-cost training programs in marketing and sales techniques with specific emphasis on telemarketing, direct mail techniques, presentation skills, and the closing of sales.*

Recommendation:

Sales training programs that are designed to improve selling skills for high technology companies operating in the export market should be largely underwritten by government. This is a key area of investment in the future of the province. Programming and financial support should be coordinated through the industry trade associations and selected educational institutions such as the B.C. Institute of Technology.

Rationale:

One of the major weaknesses of our environmental technology companies is lack of skilled, experienced management. These companies currently have few effective training options to remedy this weakness.

Strategy 4:

> *A business plan approach to guide "Environment Industry Trade Mission" activity to deliver to targeted out-of-the province, domestic, and international customers.*

Recommendation:

Government agencies that are funded to facilitate trade missions should be encouraged to participate more fully in the business planning activity preceding participation in a trade mission. Trade missions should be required to establish specific objectives and measure end results.

The international trade departments of government should focus their efforts on training seminars for business managers that lead to trade missions based on prepared business plans with documented expectations and sales objectives.

Rationale:

Trade missions should emerge out of careful planning by industry rather than from trade mission planning by government agencies. Government should act as a facilitator by providing industry with the know-how to make its own informed decisions.

Strategy 5:

> *Create facilitative mechanisms which assist companies to identify projects that would suit consortium bidding and the enhancement of a Canadian presence in international markets.*

Recommendation:

Industry and government must be encouraged to become more pro-active in seeking opportunities for partnerships and consortia building. Industry trade associations should expand their role and become a prime vehicle for coordinating individual companies in their relationship with the Ministry of International Business and Immigration, B.C. Trade Corp., Industry, Science and Technology Canada, Western Economic Diversification and External Affairs. A later recommendation references the creation of a environmental technology transfer centre. This could be a useful mechanism as well.

Rationale

B.C. environmental companies are generally small and thus require increased cooperation and assistance to compete in the world market. The Pacific Northwest Economic Partnership (PNEP) between B.C. and Washington State is emphasizing the environment industry sector. This is a positive step and the committee would be interested in working with PNEP to facilitate the flow of business within the Pacific Northwest.

Strategy 6:

> *Financial support programs for a wider range of sales campaign expenses, incoming buyers missions, and low-cost communications networks to reduce the cost of telemarketing for small or startup companies.*

Recommendation:

Expense rebate programs should be funded by government to encourage greater effort by small knowledge-based companies in communicating with potential customers in the international market. The committee is willing to work with the Ministry of International Business and Immigration and the B.C. Trade Corp. to assist in refining existing programs and to support the development of new ones.

Rationale:

Not enough government funding has been made available for marketing - one of our greatest weaknesses.

Strategy 7

To facilitate effective environment industry programming and market development an industry inventory/data base is required.

Recommendation:

In cooperation with the Canadian Environment Industry Association, the Science Council of B.C. should undertake an environment industry data base needs assessment. Based on this evaluation, survey the industry and make available a data base and inventory which makes provision for regular updating. Funding for this project should be sought from the Ministry of Regional and Economic Development, Ministry of Environment, Industry, Science and Technology Canada, Western Economic Diversification and the National Research Council.

Rationale:

To ensure effective linkages with government programming, enhanced market development and consortia building there is a strong need to ensure the existence of a regularly updated and comprehensive inventory of the environmental industry. A study is currently being sponsored by the Ministry of Advanced Education, Training and Technology to evaluate how best to develop an advanced technology data base. The environmental industry data base should link into this initiative when it is finalized.

5.2 POLICY, LEGISLATION & REGULATION

As stated previously environmental policy, legislation, and regulation has a profound effect on the environment industry. This relationship points to the need for effective communication between the environment industry and government agencies with responsibilities for environmental rule making and policy development. The committee therefore encourages the formation of mechanisms which foster enhanced industry - government communication and with this goal in mind offers the following suggestions for consideration.

5.2.1 Policy & Regulatory Objectives

- Set clear short, medium and long range environmental targets/goals.
- Advocate specific positions or actions with respect to environmental policy, regulations, and enforcement practises which flow from the preceding goals.

- Improve the level of awareness of the existing environmental regulatory structure and processes.

- Support improvement in the regulatory planning and decision making process through the application of scientific principles and research.

- Support the use of B.C. expertise in developing the environmental policy and legislation essential to long term planning and decision making, as well as the subsequent monitoring and evaluation of results.

5.2.2 Strategy & Action Plan Recommendations

Strategy 1:

> *Clarify short, medium and long term goals associated with agreed upon levels of environmental quality.*

Recommendation:

With the assistance of experts and government policy advisors develop environmental quality targets. Institute a public forum process to refine and modify the targets. Structure regulations, incentive programs and infrastructure development strategies to ensure targets are met. While the goals and objectives should be precise, industry should request flexibility in determining how the targets are met.

Pressure for predictable, consistent enforcement practises dealing with environmental regulations, by all jurisdictions.

Lobby for consideration and evaluation of market incentives and disincentives as alternatives or supplements to the basic regulatory approach.

Recommend visionary targets, policies and actions which stimulate innovative technology, and which will provide a competitive lead internationally.

Encourage province-wide monitoring systems and processes as essential components, which track effectiveness and progress and are part of the regulatory framework.

Support international marketing and trade negotiation efforts which expose and penalize international "pollution havens". Support the development and implementation of policies that are multi-national or global in scope.

Rationale:

To reduce antagonism and promote effective planning, industry, the research community and the public require a long range plan which clearly enunciates environmental goals and provides a blueprint for action. There is strategic value in setting clear environmental objectives with precise targets and time frames, while permitting industry maximum flexibility in meeting these targets. Marketing incentives/disincentives should be used as an alternative to regulatory systems wherever viable.

Strategy 2:

> *Improve the level of awareness and understanding of the existing environmental regulatory structure, decision making process, and standards.*

Recommendation:

Develop and disseminate, a regulatory "database" on environment regulations, legislation, enforcement practises, review procedures, and key contacts.

Develop information and education programs based on this data base for members of the environmental industry sector, the domestic customer base (targeted sectors), the general public, and other administrative agencies.

Rationale:

There is considerable confusion and uncertainty about environmental regulations, approval processes, monitoring and enforcement practises. There is also confusion about the relevance of these to particular industry and government operations. This, in turn, has created a situation in which the requirements for particular products and services are not clearly understood by either the environmental industry or the potential clients.

Strategy 3:

> *Improve the scientific and technological basis for planning and decision making with respect to environmental policy and legislation.*

Recommendation:

Encourage and support "baseline" environmental data collection and monitoring projects.

Encourage increased scientific research and analysis of environmental issues, especially those of special importance to the established resource industries of B.C.

Delineate environmental priorities according to an agreed upon set of criteria.

Develop a comprehensive data base of existing and alternative regulatory approaches and "non-regulatory" approaches, and identify their relative environmental effectiveness and economic impact.

Coordinate these efforts across educational institutions, government and private sector.

Rationale:

The environment has become a high-profile political issue, characterized by charged emotional debate among numerous "stakeholder" groups with varying degrees of influence and media appeal playing to a public which is generally more concerned than informed. Environmental regulators and policy makers are under tremendous pressure to respond to conflicting public demands. In the absence of a reliable knowledge base, the tendency is to adopt "solutions" which placate key interest groups, or which are visible and fashionable, though not necessarily effective. Improvements in the scientific knowledge base will greatly improve the process. The proposed Sustainable Development Foundation of B.C. could serve a useful role in ensuring these recommendations are implemented in an innovative and effective manner.

Strategy 4:

> *Support improvements in the regulatory and decision making process.*

Recommendation:

Identify inconsistencies, confusion and overlap across government jurisdictions regarding environmental regulations policies and enforcement practises. Encourage improved coordination and standardization efforts.

Encourage active participation by environmental industry firms and associations in the consultation process.

Support public information and education programs on environmental issues especially those pertaining to regulatory approaches. The new Ministry of Environment initiative is a positive move in this direction.

Informed public participation needs to be encouraged and more effective conflict-resolution mechanisms developed.

Rationale:

Improved coordination between multiple jurisdictions is required to overcome inconsistent environmental policies, regulations, review processes and enforcement practises. More effective consultation between government and industry is needed to encourage innovative and workable solutions to environmental problems. The rationale for strategy 3 is relevant here as well.

Strategy 5:

> *Promote the use of B.C. expertise in developing environmental policy and legislation which is essential to long term planning and the decision making process, as well as in the subsequent monitoring and evaluation of the results of these processes.*

Recommendation:

Advocate and support the appropriate use of local experts in environmental planning and decision-making processes.

Use locally-developed technology and environmental monitoring equipment to support the development of a competitive export industry.

Rationale:

There is a growing knowledge and skill base in this field which has the potential to enhance the effectiveness of environmental decision making by governments and industry. This is a business opportunity for the Province. A number of enabling mechanisms could serve these recommendations, including the use of:

- an Advisory Council
- the proposed Sustainable Development Foundation of B.C.
- the proposed Western Environmental Technology Advancement Centre

Strategy 6:

> *Advocate improvements in the environmental standards applied to procurement practises at all levels of government.*

Recommendation:

Set out clear environmental procurement policies with input from the environment industry. Couple these policies with programming designed to assist government to adopt environmentally safe practices.

Rationale

Government procurement of environmental products and services directly or indirectly represents a substantial portion of the domestic market for the B.C. environmental industry. Government can stimulate new markets for products by being a first purchaser. It can also help to overcome 'system inertia' for products which have a long history of use coupled with complex infrastructure. The petroleum fueled automobile is one of the most used examples of this concept.

5.3 ENVIRONMENTAL SCIENCE & TECHNOLOGY

The committee believes the fundamental underpinnings of a winning environmental business sector in B.C. hinges on the application of solid applied and basic environmental science coupled with effective technology transfer. Although the committee recognizes the integrated nature of the proposed strategy, it is felt that without adequate research and technology development the basis of a strong and diverse environment industry will not be evident.

5.3.1 Science & Technology Objectives

- Create a world class environmental business sector in British Columbia. Although existing companies are small, many have achieved international status. The established primary resource industries in B.C. have permitted the development of aggressive and unique environmental companies.

- Achieve excellence in training, education and research facilities in the province to support the industrial demands for technicians, scientists and research capabilities.

- Ensure provincial government commitment to support science and technology as a critical requirement for the development of a secondary manufacturing sector in the province. Support the effective implementation of the Provincial Science and Technology Policy.

- Through the implementation of several key science and technology strategies, capitalize on our strengths, reduce or eliminate inherent weaknesses and ultimately realize a flourishing environmental sector.

The committee recognizes the implementation of many of the recommended actions will not necessarily be easy since some are universal problems not unique to B.C., such as conflicts over intellectual property rights. But however difficult or common, these problems must still be addressed to ensure a flourishing industry.

5.3.2 Strategy & Action Plan Recommendations

Strategy 1:

> *Encourage increased interaction between education/training institutes and industry for market- driven R&D. Establish a centre of excellence in environmental science.*

Recommendation:

Establish a **Sustainable Development Foundation** which would commission and fund independent research in areas relating to environmental challenges, the environment-economy interface, setting of environmental research priorities, and with the clear mandate to develop a Center of Excellence in Environmental Science for B.C.

The Foundation would also encourage increased interaction between educational/training institutes and industry for market-driven R&D.

It would integrate the latest in information sciences to create a library, and information collection and collating system for B.C. companies engaged in environmental sciences.

Rationale:

There is a strong need to apply science and technology development to environmental problems, both as a way of solving environmental challenges and also to serve as a source of ideas and new technologies which can be applied in the marketplace. Moreover, a continuous stream of up-to-date intelligence must be made available to nurture companies along successful international paths. Finally, these companies will need increased interaction with education and training institutes to access the information and personnel they need to succeed.

Strategy 2:

> *Encourage and develop effective mechanisms for business incubation and technology transfer from domestic and foreign sources.*

Recommendation:

The committee recommends the formation of a **Western Environmental Technology Advancement Centre** which would serve as an industry incubator and technology transfer agent. The service area would be the four western provinces and the location would be in the lower mainland or Victoria. Funding should be sought from both the federal and provincial governments. The existing environment industry is not sufficiently large to underwrite a significant portion of the up front costs of setting up such a centre, however it is important the centre institute mechanisms to be self sustaining within five to seven years.

Services offered could include: technical support services; sub-contracting of testing, evaluation and product demonstration; market analyses and business plan development; domestic and international technology transfer; facilitate permitting, approvals and patenting; identification of promising new technologies; provision of education and training through newsletters, seminars, workshops and conferences.

One of the most effective ways to transfer technology is by demonstration. The Centre could play a pivotal role in demonstrating environmental technologies for the proposed clean-up of the Fraser River and the Expo lands. The Centre could serve to coordinate cooperative environmental technology development and consortia building between and within western provinces and might even extend to the pacific northwest.

Rationale:

If the provincial goal is to substantially increase secondary manufacturing, the subject of technology transfer must be treated seriously. Since Canada produces less than three per cent of the world's technology supply, companies would do well to look at foreign sources for the technology they need to produce their product. It is more efficient for one agency to acquire such information than for a large number of small companies to search out such technologies on their own.

Strategy 3:

> *Encourage resource-based companies to allocate a minimum amount of R&D funds to universities and smaller B.C. companies.*

Recommendation:

The province should consider tax/stumpage/greening incentives to encourage the multi-national resource-based companies to make R&D funds available, or

alternatively collect fees which are deposited into a trust fund specifically earmarked for environmental R&D. The allocation of the funds would be a function of the proposed Foundation for Sustainable Development and/or the Western Environmental Technology Advancement Centre. These funds, when coupled with provincial and federal resources could go a long way to ensuring the requisite environmental R&D and technology transfer is completed.

Rationale:

The resource sector in B.C. is large and an excellent potential market for developing a local environment industry. Our multi-national primary

resource companies however, spend a lamentably small percentage of their income on R&D. There is currently little incentive for them to invest more on R&D.

Strategy 4:

> *Recognize pre-eminence in environment science and technology by consolidating the areas of excellence and specialization.*

Recommendation:

Focus on those areas of excellence which are unique to B.C. companies and which are least likely to be pre-empted by companies in other countries. In concert with industry, government should develop a 'map' of the strengths of the B.C. (western?) environmental industry and develop domestic and international strategies for the effective marketing of products and services.

Rationale:

Building and focussing on its unique technological strengths and expertise, B.C. can fill a niche with world-wide market implications.

Strategy 5:

> *Encourage linkages among the Information Sciences, Biotechnology and Environmental Sciences.*

Recommendation:

Encourage linkages among companies identified with the SPARK initiatives of Information Science, Biotechnology and Environmental Science. Establish a sub-committee to identify those areas of biotechnology and information

sciences that have application to environmental concerns. Initially this should focus on the three primary resource areas of forestry, mining and fisheries.

Rationale:

B.C. must take advantage of its competitive strengths in environmental science and technology by consolidating and enhancing existing areas of excellence and specialization. Much of this excellence has been developed to satisfy environmental problems in B.C.'s primary resource industries of forestry, mining and fishing.

Strategy 6:

> *Encourage the development of a sound manufacturing sector based on reliable science and technology. Recognizing the long time frame needed to achieve this goal, encourage this development in the shortest time possible.*

Recommendation:

Appropriate mechanisms must be established to accelerate the development of a sound manufacturing sector. Establish a sub-committee charged with the responsibility of liaising with the SPARK Manufacturing initiative. Establish terms of reference prior to meeting with counterpart committees.

Rationale:

It has been often repeated that B.C. needs to diversify its economy away from dependence on resource-based industries. The establishment of a secondary manufacturing sector is an attractive option, but much work needs to be done quickly to move the process forward.

5.4 THE WORK FORCE

This chapter discusses the need for well trained personnel who can serve the needs of the environmental industry. Clearly a portion of the work force can be brought in from other places, however there is a clear linkage between the academic research community and the training of skilled scientists and engineers. It is therefore important to support the academic institutions which provide such personnel and to ensure the industry is a full partner and guiding the universities and technical schools through effective consultation. The SPARK process can play a role in this regard in identifying for the academic community the needs of the industry.

5.4.1 Objectives

- Create a positive perception of the role of science and technology in order to create a more favourable climate to interest students in environmental science and engineering careers, and to provide the public with a clearer understanding of environmental protection issues.

- Generate a solid base of educated and appropriately-trained workers, able to address all facets of product or service delivery, including: research and innovation; manufacturing, engineering and technology; and marketing, financial management and administration.

- Support the development of apprentice and/or internship programs similar to our international competitors. This should be coupled with the enhanced ability of our educational institutions to quickly retool to produce needed workers in appropriate areas.

- Facilitate manufacturing and design experience in our engineering and technology graduates in order to translate ideas into marketable products which can then feed into the creation of viable manufacturing companies.

- Encourage a good grounding, on a continuing education basis, in the basics of economics, environmental regulations and impact assessment, and business administration for science and engineering graduates.

5.4.2 Strategy & Action Plan Recommendations

Strategy 1:

Build a work force made up of skilled professionals based on existing expertise by providing the necessary incentives to retain them against outside recruitment and providing incentives for further management training through continuing education.

Enhance the pool of skilled technical workers by apprenticeship programs, college training, the retraining of displaced workers, and the translation of skills in related areas into environmental industry applications.

Enhance the level of awareness and competence of companies trying to meet the challenges associated with the new environmental reality.

Recommendation:

Strike a task force to evaluate undergraduate, graduate and continuing education programs currently available in B.C. colleges, institutes and universities in the environmental training area. The task force should include representation from colleges, universities, the Ministry of Education, Ministry of Advanced Education, the Training and Technology, the Ministry of Environment, the environmental industry and K-12 teachers. (To be undertaken by MAETT and MOE.)

Complete an inventory of environmental industry work force needs by commissioning a survey of companies and businesses in the sector. (To be conducted by the Science Council of British Columbia.)

Encourage the development of companies specializing in environmental training, both as a business opportunity and as a service to companies requiring assistance coping with the new environmental reality.

Rationale:

B.C.'s young industries are facing a crisis in the shortage of skilled personnel and resources for training enough recruits are not currently available. As well, a high percentage of skilled scientists and technologists leave B.C. to pursue their careers elsewhere. If we take the right measures, we can supply our personnel needs with existing human and educational resources. It is too early to evaluate the impact of the provincial government's Environmental Youth Corps program on stimulating young people to train in the environmental sciences. The program, if successful could have lasting benefits for the industry.

Companies under challenge by existing and proposed environmental regulations will require expert assistance in achieving compliance. Personnel operating new equipment will also require ongoing training to ensure competence. Companies providing such training represents a significant new business opportunity for the emerging environment industry.

Strategy 2:

> *Influence future societal attitudes towards the role of science and technology and promote career choices in engineering and science-related areas.*

Recommendation:

Promote career choices in engineering and science through visits to the classroom by working professionals at the junior high level. Liaise with

Faculties of Education on positive presentation of science and technology to student teachers and in curriculum development. Encourage science teacher specialization in Faculties of Education. Raise public awareness of the value and role of science and technology in solving environmental problems through adult interest and education courses in colleges, universities and through the Open Learning Agency and Knowledge network. The Scientists in the Schools program sponsored by MAETT is useful in this regard and the committee supports the need for such programming.

Through a variety of media, publicize the importance of the environmental industry (Science Council) with the goal of generating a more positive attitude toward science and technology. Disseminate information on the state-of-the-art progress in the industry and educate the public on the nature of risk analysis and the relationship between the environment and the economy.

Rationale:

A vigorous campaign promoting the role of science and technology in British Columbia and its value in the environment economy of the province will help educate the public to become more informed advocates of environmental reform. The intent of such a campaign would be to encourage more people to pursue careers in environmental science and technology. Programming by MAETT in this area is useful and the committee would be pleased to work with the Ministry to ensure the industry has a voice in the implementation of this initiative.

Strategy 3:

> *Encourage co-operative education as a means to provide students with relevant industrial experience while promoting university-industry liaison.*

Recommendation:

Provide hands-on opportunities in industry for cooperative education students at the undergraduate level, and work experience for college technology and institute students.

Promote field work as a part of graduate training in non- traditional areas (chemistry, engineering) even when co- operative education (paid work) is not involved. Highlight problems in B.C. or those having relevance to the province.

Support joint college - university collaborative projects involving the environmental industry, technology transfer and graduate academic training.

Rationale:

B.C. graduates are well-grounded in theory, but need more practical, on-the-job skills when they enter the work force. Cooperative education and similar programs provide students with real-world training, while promoting university-industry liaison.

Strategy 4:

> *Provide education programs for existing employees of technology companies to update skills,and broaden abilities, especially in management.*

Recommendation:

Encourage industry to train managers able to meet the new management challenges inherent in high tech companies. Direct colleges/institutes to regularly offer responsive courses for middle and senior management in the manufacturing sector. Encourage the trainers to actively market their products in a more aggressive manner than at present.

In continuing education, implement specific comprehensive diploma programs in managerial skills and business/financial planning, and stress new technology updates for technical and research staff. Liaise with the Open Learning Agency in delivery of distance education courses in environmental technology and new developments.

Solicit special funding from government to provide reasonable tuition costs and to attract quality instructors with the necessary expertise (B.C. and beyond).

Advocate courses in business, economics, conflict resolution and regulatory/political aspects for science and engineering students with environmental specialization. Explore blue ribbon management courses employing CEO level participants from successful foreign environmental technology firms.

Encourage coordinated efforts by universities and colleges to establish high quality, authoritative, technical, socioeconomic, business and management extension courses.

Rationale:

Technology-based industries are constantly and rapidly changing and becoming more complex. The skills of workers, and especially top-level managers in technology companies quickly become out-of-date. They must be retrained on a

continual basis to acquire the new skills and knowledge they need to be competitive.

Strategy 5:

> *Encourage educational institutions to produce graduates trained in areas of practical use to the B.C companies that will employ them.*

Recommendation:

Encourage universities and colleges to emphasize design/ manufacture/problem solving in the education of engineers, scientists and technologists. Practical on site work experience by students (cooperative education programs) would assist in the development of graduates who would be more capable of starting up new manufacturing companies. Some Scandinavian countries have successfully used such methods to develop their own manufacturing sector.

Rationale:

Technology companies need graduates that can solve real-world problems they face in the design and manufacture of products. Today's graduate are often well-grounded in theory, but have not had enough exposure to the practical aspects of their field. On site experience also aids in knowing how to design and manage the formation of a new manufacturing enterprise.

Strategy 6:

> *Attract and retain top scientists, engineers, and technicians.*

Recommendation:

Develop effective incentive programs to attract top scientists/engineers/ technicians to B.C. and retain those who are already here. Deal with remuneration, research opportunities, equipment, operating funds, intellectual property rights, patents, publication.

5.5 FINANCING THE ENVIRONMENT INDUSTRY

5.5.1 Introduction

This section is, to a large extent derived from the SPARK Fiscal Committee report. As stated previously, the Environment Committee acknowledges a variety of constraints to the development of the environment industry which

are generic to the advanced technology sector as a whole. Since the audience for the environment sector report is largely different from the fiscal committee report, it was decided to include the main thrust of their report to stimulate discussion about perceived fiscal issues impacting on the environment industry. However, the environment committee recommends that detailed discussions of these fiscal proposals await distribution of the fiscal committee's report expected in October.

There are two distinct problems in the venture capital marketplace; a lack of *knowledgeable capital* and a lack of quality management teams. By *knowledge* in this instance we mean:

- the care and attention which comes when experienced people watch carefully over their own money;
- access to market data (where "marketing" refers to product definition and corporate positioning);
- access to additional sources of key personnel, and the ability to advise management when changes must be made in senior personnel;
- access to strategic relationships;
- a truly global understanding of business evolution;
- know-how to grow a company to the size where it can assume some permanence (at least $50 million).

Canada has a very small collection of professional venture capital management teams. The new generation of practitioners is leaving, not arriving. It is clear the growth in both Silicon Valley and Route 128 (Boston) has in large part been accomplished by a vigorous venture capital industry. And the reasons are interesting: it appears the benefits of the venture capitalists are not so much money as the discipline and management expertise they bring.

The Small Business Venture Capital program has not produced any winners (though significant funds have been invested), and in particular has produced no new teams of venture capital pool managers. In any case, it does not focus on knowledge-based companies. The Investor Immigration program has produced next to no real venture capital. It is likely true that the SBVCC program is too young to have shown results, but the lack of pools is disappointing.

The usual sources of risk capital such as wealthy individuals, corporations, and institutions such as pension funds and life companies, are not encouraged to participate in the formation of knowledge-based companies. This is in part

because of the required conservatism of the institutions, the low Canadian savings rate, and the competition in an era of high interest rates from more secure forms of investment.

Typical high-growth, knowledge-based companies cannot afford debt, even if it is available. If they are to win, they must consume cash, and their ability to repay is necessarily restricted. This is why a program of loan guarantees should be used only in very specific circumstances (e.g. in proportion to equity and provided they are used for purposes such as fixed assets and inventory). These early-stage companies generate little net cash for many years, and debt payments will impact severely on needed discretionary expenditures on product development and marketing.

5.5.2 Strategy & Action Plan Recommendations

The fiscal committee's basic thrust is that simply providing access to capital does not by itself solve fundamental problems. Self-sustainability in knowledge-based industries requires a 'critical mass' composed of three equally important legs:

- high quality research and development closely associated with catalysts to commercialize results;
- high standard of company managers and technical personnel;
- knowledgeable sources of funds.

Within this framework, the draft Fiscal Committee report contains a number of key recommendations. As stated previously, the environment committee has extracted these and in certain cases reworded them to reflect their own emphasis.

Strategy 1:

> *Create a mechanism which will assist in the commercialization of new technologies and assist in the coordination of existing R&D efforts.*

Recommendation:

Establish a new corporation whose specific purpose is to commercialize worthwhile R&D projects from B.C.'s universities and research labs. It is to be owned by the universities and government and eventually by the private

sector. It would be managed in accordance with private sector principles and would have the mandate to commercialize technologies at those institutions.

Rationale:

To combine the commercial efforts of the university system and to encourage private sector funding into such activity.

Funding would initially come from government and would require an estimated $16 million over five years.

Strategy 2:

> *Attract top management talent, through the provision of a high level management development program.*

Recommendation:

A plan should be put in place by which the province makes loans to knowledge-based companies to cover a proportion of the extra costs of obtaining qualified personnel from outside the Province.

To keep this from being open ended, we suggest that the loans be automatic, but be capped at the lesser of 50% of eligible expenses or $50,000. Eligible expenses include search costs, moving expenses and real-estate relocation differentials.

We recommend that the Province urge the Federal Government to alter the $500,000 capital gains exemption with the express purpose of providing untaxed capital gains to managers and employees who prove their worth over time.

The exemption should be available only to genuine full-time employees who buy the shares of companies when they are private and sell the shares only after having owned them for at least five years, three of which they continued to be genuine full-time employees. As well, at any one time, the person can own the shares of only one company which qualifies for the exemption.

The province should not undertake this on its own, as this might complicate income taxing arrangements, but it should urge Ottawa to implement the measure nation-wide.

Rationale:

To compete with the rest of the world, B.C.'s knowledge-based environmental companies need access to world-class personnel. Presently, these companies are

not in a competitive position to attract key people. One reason is that search, moving and relocation costs represent real barriers to obtaining critical persons, especially those coming from the United States. Another reason is that B.C. companies cannot afford the high cash cost of competitive salaries. This disadvantage could be offset by a change in Federal capital gains legislation to provide potential for equity gains.

Strategy 3:

Develop a high level management development program.

Recommendation:

In partnership with industry, the province should institute a Management Development program in cooperation with leading venture capital management groups and technology companies in the U.S. to subsidize the salaries of potential B.C. managers deemed good enough by those companies to work and learn in the heart of that community.

Beneficiaries would be required to return to B.C. The potential recipient of the Management Development Program would have to seek out a position with a sponsoring company and would then apply under the program.

Rationale:

Institutions will fund only experienced venture managers. Unfortunately, there are very few companies in B.C. which can serve as training grounds. And the committee believes that it is crucial to have managers of technology-based companies exposed to the experience of highly qualified management teams elsewhere.

Strategy 4:

Generate creative provincial government investments for knowledge based companies (some of which are 'automatic') rather than the tax system, coupled with provincial partnerships with private sector equity funds.

Recommendation:

Help to establish venture capital pools.

Encourage provincial investment which complements and encourages private sector investors in knowledge-based companies.

Rationale:

Studies indicate the creation of venture pools in an area, even if much of the money is invested outside the area (in this case, B.C.), foster the development of new industry. The national and international networking of professional pools of capital leads to cross investment.

Strategy 5:

> *The Province should supply matching investments for knowledge-based companies.*

Recommendation:

The province should provide matching investments for those knowledge-based companies which raise significant amounts of private-sector funds.

A knowledge-based company meeting certain conditions should automatically obtain a matching investment of 60% of eligible matching permanent private sector equity, from a minimum of $300,000 to a maximum grant of $12 million. The Province could receive a royalty on revenues at a pre-determined rate capped after the invested funds had been repaid.

Rationale:

Knowledge-based companies should be encouraged to seek private venture capital, as this capital brings with it management expertise and experience which greatly enhanced the company's chances of success.

Strategy 6:

> *Use labour union venture pools for investment in B.C.'s knowledge-based companies.*

Recommendation:

The Province should pass legislation that will permit the sale of labour-union-based venture pools (such as the Canadian Federation of Labour's Working Ventures).

Rationale

The sale of labour union venture pools has been proposed by the Canadian Federation of Labour, and has been approved by Ottawa and some other provinces. It is an excellent vehicle not only to mobilize individuals' savings, but to educate them in the long-term issues of technological change.

APPENDIX 1

SUMMARY OF PRIMARY ENVIRONMENTAL INDUSTRIES ACTIVIES

(The Study was commissioned by the B.C. Ministry of Regional and Economic Development)

Summary of Primary Environmental Industries Activities

Sponsor	Program	Description
Federal Government	1990 Federal Budget	The 1990 Budget is expected to be a "green budget" with possible tax and expenditure measures designed to "integrate" the economy and the environment.
Federal/Provincial Government	Globe '90	Trade fair and conference to promote environmental industries.
Environment Canada	DDRECT	Development and Demonstration of Resource and Energy Conservation Technologies provides capital assistance to eligible projects.
Environment Canada	Strategic Environment Action Plan	Details unknown but could be linked to Federal 1990 Budget initiatives.
Industry Science and Technology Canada	Environmental Industries Sector Initiative	Multi-year development program aimed at data collection, supply capability profiles and market studies.
British Columbia Trade Development Corporation	Environmental Industries Sector	The Trade Corporation is working on several initiatives to enhance export opportunities.
Energy, Mines and Petroleum Resources	Clean Energy Program	Energy-from-Waste assistance will lead to commercial environmentally beneficial projects.
Science Council	SPARK study	Environmental industry strategic plan study being proposed.
Ministry of Environment	Solid Waste Management	Components of this plan will have commercial spin-offs.
Purchasing Commission	Environmental Purchasing Policy	Policy supports markets for recycling and environmentally sensitive products.
Economic Development Commission of Greater Victoria	Environmental Enterprise	Development of environmental industries database.
Canadian Environmental Industry Association	Industry Association	Industry association established in 1989 to promote the development of environmental industries.

Source: G.E. Bridges and Associates Inc., "A Summary of Business-Oriented Environmental Industry Activities in British Columbia", (December 15, 1989), Preliminary Draft.

Summary of Complementary Environmental Industries Activity

Sponsor	Program	Description
Federal Government	Western Diversification	Promotes diversification of Western Canadian economy.
Federal Government	Federal Business Development Bank	Provides alternative financing.
Industry, Science and Technology, Canada	World Information Network for Exports	Provides Canadian Trade Commissions with information on Canadian supply capabilities.
Industry, Science and Technology, Canada	Program for Export Market Development	Funding for export market development.
National Research Council	Technology Inflow Program	Promotes Canadian technological innovation.
Ministry of Regional and Economic Development	Programs under the Industrial Development and Small Business Incentives Agreements and Small Business Venture Capital Program	Promotes industrial and small business investment through loan and venture capital assistance.
Ministry of Advanced Education and Job Training	Several research oriented programs such as Discovery Enterprises Inc. and those under B.C. Research	Research assistance for development of new technology.
Ministry of Energy, Mines and Petroleum Resources	Clean Energy Program	Energy Efficiency and Technology component providing hydrogen and CNG development funding.
Ministry of Government Management Services	Environmental Champions Action Plan	Ministry wide environmental awareness program.
Ministry of Agriculture and Fisheries	Programs aimed at reducing impacts of intensive production	Soil management activities and effects to minimize pesticide and herbicide use.
B.C. Trade Development Corporation	Export Loan Guarantee	Loan guarantee of 85% of a loan up to $2.5 million for working capital for export development.

Source: G.E. Bridges and Associates Inc., "A Summary of Business-Oriented Environmental Industry Activities in British Columbia", (December 15, 1989), Preliminary Draft.

APPENDIX 2

ADDRESS BEFORE THE EPA/IACT INTERNATIONAL CONFERENCE ON POLLUTION PREVENTION

ADDRESS BEFORE THE EPA/IACT INTERNATIONAL CONFERENCE
ON POLLUTION PREVENTION

Omni Shoreham Hotel
Washington, D.C.

June 13, 1990

Barry Commoner

CBNS

CENTER FOR THE BIOLOGY OF NATURAL SYSTEMS
QUEENS COLLEGE, CUNY FLUSHING, NEW YORK

This conference comes at a crucial moment in the history of environmentalism. Two months ago millions of people in dozens of countries bore witness to the elevation of the environmental crisis to the top of the global agenda. Even more than the first Earth Day 20 years earlier, Earth Day 1990 confirmed the nearly universal commitment to restoring the quality of the environment.

But the two Earth Days differ sharply in their results. In 1970, Earth Day was the signal for action: a series of far-reaching environmental laws were passed; the U.S. Environmental Protection Agency (EPA) and state environmental agencies were established; local clean-up campaigns were organized; schools adopted new environmental courses. In 1990, Earth Day has come -- and gone -- leaving scarcely a trace in the country's life. No new remedial programs have been proposed; the Congress is still debating a Clean Air Bill that -- failing to recognize what we have learned over the last 20 years -- was obsolete on the day it was written; a curious silence has descended on the airwaves and editorial pages.

The chief message about how to clean up the environment that emerged from the recent festivities is: do it yourself. Some examples, gleaned from one of the numerous published lists: "live within walking distance of your job; carry your own shopping bag; keep the lint screen in the clothes dryer clean; be creative with leftovers; go barefoot." Virtuous as they are, these measures are hardly adequate to a world confronted with the massive task of preventing global warming and ozone depletion, of eliminating

smog and acid rain, of sharply reducing exposure to toxic chemicals.

I have been particularly concerned about this discrepancy because early on I called for a new understanding of the environmental crisis: to explain why, despite the huge and costly effort, the environmental problem persists; to prevent pollution instead of trying to control it; and to achieve that through a massive, world-wide transformation of our systems of agriculture, manufacturing, energy production, and transportation.

This urgent message, I regretfully report, was lost in the glamorous din of the recent Earth Day. In the quiet aftermath we are obliged, I believe, to speak out and, as clearly and as forcefully as we can, awaken the world, not simply to the size and urgency of the problem -- that is well known -- but to the monumental scope and radical impact of the necessary remedy. We need to fill the vacuum left by the trivialization of Earth Day and -- as I shall show -- by the failure of this Administration to provide leadership in the new, more meaningful direction.

To appreciate the sweeping significance of pollution prevention as the guiding strategy for resolving the environmental crisis, we need to go back 20 years, to the law that defined U.S. environmental policy -- the National Environmental Policy Act (NEPA). The stated purpose of that Act is:

> "To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which <u>will prevent or eliminate damage to the environment and biosphere</u> and stimulate the health and welfare of man." [emphasis added]

What is most significant about this clear-cut statement of U.S. environmental policy is that for 20 years it was ignored. The simplest evidence is that 20 years after NEPA, in the Federal Register of January 19, 1989, EPA found it necessary to announce pollution prevention -- as a new policy. In the Pollution Prevention Policy Statement signed by the former Administrator, Lee M. Thomas on that date, the novelty of this position is made quite clear. The statement acknowledges that EPA's past effort "had been on pollution control rather than pollution prevention" and asserts that "...today's notice commits EPA to a preventive program to reduce or eliminate the generation of potentially harmful pollutants."

I have emphasized the word "generation," because it sharply distinguishes the new policy from the old one. The earlier, control strategy accepts the existence of the facilities that generate the pollutants -- the automobile or the power plant -- and then prescribes appended control devices -- catalytic converters or scrubbers -- to trap the pollutants before they can enter the environment. Prevention, instead, calls for replacing the present facilities themselves with new kinds of cars and power plants that do not generate the pollutants, obviating the need for a control device.

In the 20-year period between NEPA's pronouncement that pollution prevention is national policy and its adoption by EPA, the United States has made a massive effort to restore the quality of the environment. More than $1 trillion of public and private money has been spent to control rather than prevent pollution; impressive bureaucracies have been created; numerous

regulations have been enacted. But with what results? Mr. Thomas' policy statement answers this question diplomatically: "...EPA realizes that there are limits as to how much environmental improvement can be achieved under these [i.e., control] programs." I can be less diplomatic, and assert as I did in an earlier address to the EPA staff (in January 1988) that "...the massive effort that began in 1970 has failed to restore the quality of the environment."

At that time, and more recently in my book, Making Peace with the Planet, I reviewed the available numerical data regarding emissions and environmental concentrations of pollutants that lead to this conclusion. It is useful to summarize these data here, for they show not only that the control strategy has failed, but more important, that -- in the very few instances in which, more or less by accident, it has been applied -- the prevention strategy has succeeded.

The data show that, with very few exceptions, the effort to reduce the emissions and environmental concentrations of pollutants has failed. Improvement in annual emissions of the standard air pollutants -- particulates, sulfur dioxide, carbon monoxide, nitrogen oxides, and volatile organic compounds -- has been modest at best. Between 1975, when the acquisition of uniform annual data began, and 1987, the average reduction in these emissions was only 18%, including a 2% increase in nitrogen oxide emissions. Similarly, a U.S. Geological Survey study of the levels of standard water quality factors -- fecal coliform bacteria, dissolved oxygen, nitrate, phosphate, and suspended

sediment -- at several hundred river sites throughout the country shows that between 1975 and 1983 the average levels improved at 13.2% of the sites; they deteriorated at 14.7%; and remained unchanged at 72.1%.

Qualitative improvement of the order envisaged in the environmental legislation of the 1970s -- 70% to 90% -- has occurred only in the case of a handful of pollutants: airborne lead emissions, which have declined by 94% between 1975 and 1987; DDT and PCB concentrations, which have declined in human body fat by 70-80% in the decade following 1970; mercury concentrations in Great Lakes sediments, down by 80% between 1970 and 1979; strontium 90 concentrations in milk, which have declined by 92% between 1964-1984; and, in a few local sites such as the Detroit River, a 70% reduction in phosphate concentrations between 1971 and 1981. The numerous failures and the rare successes tell the same story: pollution prevention works; control devices do not. Environmental pollution is an incurable disease; it can only be prevented.

Every pollutant on this very short list of successes reflects the same remedial action: production of the pollutant has been prevented. Lead has been almost entirely removed from gasoline; DDT and PCB have been banned; mercury has been removed from chloralkali production; where phosphate has been eliminated from detergents, concentrations in surface waters have declined; the atmospheric nuclear bomb tests that produced strontium 90 have been halted.

In each case the production process that originally generated the pollutant has been changed. In gasoline

production, lead has been replaced by organic octane boosters; in cotton production, DDT has been replaced by other insecticides; in transformer production, PCBs have been replaced by other dialectric fluids; in chloralkali plants, semipermeable membranes are now used in the electrolytic cells instead of mercury. In sum, the strategy of pollution prevention requires an appropriate change in the technology of production; the change entirely eliminates the pollutant, reducing emissions to zero. In contrast, the strategy of control attempts only to reduce the amount emitted -- and fails to do so appreciably.

One of the rules of environmentalism is "There is no free lunch," a reminder that there is a cost associated with every environmental mistake. The mistaken strategy of control is no exception. It has not only rendered futile the huge 20-year effort to clean up the environment, but has also created new problems that could have been avoided had the strategy of pollution been implemented instead of being entombed in NEPA.

A major consequence of the effort to combat pollution by applyihg control devices to the otherwise unchanged facilities that generate it is the much-lamented -- but spurious -- conflict between environmental quality and economic development. This conflict has led to the claim that since economic development depends on increased use of the same technologies that generate pollutants -- modern automobiles and trucks, fossil fuel and nuclear power plants, or chemical agriculture -- then it follows that environmental quality demands limits on economic growth. This claim has a chilling effect on communities and countries

that are struggling to overcome the most serious assault on the quality of life -- poverty.

Experience with the strategy of control appears to confirm the reality of this conflict. Thus, one reason why emissions from motor vehicles and power plants have decreased only slightly since 1975 is that vehicular fuel consumption has increased by 11.3% and electric power production by 9.8% in that period of time. Since they are never perfect, the increment in overall activity counteracts the modest reduction in emissions that the control devices can achieve. On the other hand, when a preventive measure is employed -- for example, removing lead from gasoline -- emissions are reduced to zero regardless of the level of activity. After all, any number multiplied by zero remains zero.

Thus, if we rely on control devices that only partially reduce emissions, then increased activity will counteract their effect -- and there is, indeed, a conflict between environmental quality and economic development. Nor can this conflict be relieved by raising the efficiency of the control device to 100%, for this inevitably involves exponential increases in their costs -- adding to the cost of production and, again, generating a conflict between environmental quality and the economy.

In fact, changes in production technology motivated by pollution prevention will often themselves improve economic productivity. For example, in the United States, the economic productivity of agricultural chemicals -- i.e., the dollar return on the investment in them -- has decreased by some 70% since they were introduced in 1950. There is now a good deal of evidence

that the prevention-motivated alternative -- organic agriculture -- is economically successful compared with conventional agriculture. Similarly, with the cost of producing fossil fuels inevitably escalating as supplies are depleted, solar alternatives that are renewable and therefore stable in cost become economically advantageous. Indeed, it is safe to say that if American industry would gear up to produce smogless cars and trucks, low-cost sources of solar energy, and processes that sharply reduce the environmental burden of toxic chemicals, it could recover a good deal of the vitality that it has lost to other, more innovative, national economies.

This conference testifies to the fact that the principles of pollution prevention have been widely appreciated and are beginning to be applied. Efforts are being made to reduce the amounts and toxicity of the wastes that are generated, and where possible to recycle them. Pollution prevention is beginning to move from policy to practice.

But there are serious obstacles which, unless they are confronted and resolved, will, I believe, hold back the full-scale development of the strategy of prevention and -- once again -- frustrate our effort to restore the quality of the environment. In order to identify these obstacles and come to grips with the task of overcoming them, we need to look at some of the larger implications of implementing the strategy of prevention. For this purpose it is useful to examine a specific -- and large-scale -- source of environmental pollution: the automobile.

In the 1970s the automobile was recognized as the source of at least several major environmental pollutants: carbon monoxide, photochemical smog, and lead. Guided by the strategy of control, EPA tackled the problem by prescribing a control system to reduce emissions of carbon monoxide and nitrogen oxides. In a detailed rule-making document, EPA prescribed specified control devices and predicted that they would reduce national carbon monoxide emissions by 80% and nitrogen oxide emissions by 70% between 1975 and 1985. This prediction turned out to be far off the mark; in fact, carbon monoxide emissions declined by only 19%, and nitrogen oxide emissions <u>increased</u> by 2% in that period. And since nitrogen oxides trigger smog production and contribute significantly to acid rain, there has been little improvement in these important environmental problems.

The original estimates took into account the several relevant factors, including the efficiency of the control system (chiefly the catalytic converter) and the expected increase in traffic. The failure to achieve the predicted reductions revealed that the efficiency of the control system was insufficient to overcome the approximately 11% increase in automotive fuel consumption over that period. Meanwhile, it was discovered that lead, then widely used in gasoline as an octane-booster, poisoned the catalytic converter's platinum catalyst, and EPA moved to rapidly eliminate lead from gasoline production. As a result, national lead emissions (from all sources) has declined by 94% since 1975. This is one of the few real environmental successes; it has reduced the toxic effects of lead emissions, for example in inner-city children where it had been

sufficient to account for symptoms of mental retardation.

The sharp reduction in lead emissions shows that pollution prevention works; the failure to significantly reduce carbon monoxide and nitrogen oxide emissions shows that the control strategy does not.

How could the principles of pollution prevention be applied to carbon monoxide and nitrogen oxides? The basic principle is clear from the example of lead: change the technology of production so as to eliminate the pollutant at its point of origin. The generation of both carbon monoxide and nitrogen oxides is inherent in the operation of the automobile engine -- in one case, because of incomplete combustion, and in the other because of the elevated temperature of high-compression engines. The principle, then, is to change the engine so as to eliminate its propensity for producing these pollutants. The generation of nitrogen oxides can be eliminated by reducing the engine's compression ratio or by redesigning it to localize the high temperature (as is done in the stratified charge engine). But carbon monoxide production can be eliminated only by doing away with the internal combustion engine itself, for example by using an electric motor instead.

For the sake of this example, let us agree that both carbon monoxide emissions and the generation of nitrogen oxides and the resultant photochemical smog should be eliminated by replacing the present automobiles with electrically driven ones. The first fact to take note of is that this clean automotive technology <u>exists</u>. It was widely used in the 1920s when, as I recall, the

trucks operated by the Railway Express Company (the predecessor of American Express) in New York City were driven by electric battery-powered motors. Indeed, General Motors has recently exhibited a prototype electric car that they state will be produced for sale at some unspecified date. Thus, there is at present no technological barrier to replacing the present cars, at least in urban areas, with electric ones, thereby eliminating most urban air pollution -- a notorious, unsolved environmental problem.

Why, then, has this urgently needed example of pollution prevention not been adopted? There are, of course, numerous obstacles to this much-to-be-desired eventuality. The most important one is that General Motors is understandably reluctant to invest in the necessary new production facilities until a sufficiently large demand for the car is established. Unlike conventional cars, there is at present no existing market for electric cars. And so we are frozen into inaction.

Yet there is a way to break out of this paralysis and begin the large-scale introduction of electric cars, at least in urban areas. The federal government buys about $7 billion of cars and trucks annually, many of which could be suitably replaced by electric vehicles. Many such vehicles are also purchased by state and city governments. Taxis, which make up a considerable part of the traffic in cities like New York, although privately owned, are subject to municipal regulations regarding their design. Surely this represents a demand for electric cars sufficient to enable General Motors to invest in producing them -- creating at once a market that will facilitate private

purchases as well. In sum, federal and other government orders for the purchase of electric cars -- or, for highway travel, cars with stratified charge engines -- is a practical way of generating the transformation in transportation technology that is the only effective means of lifting the heavy burden of vehicular air pollution.

What can be done in the area of electric power production -- another major, persistent source of environmental pollution? The environmental consequences of our present technologies are well known: power plants that burn coal, oil or natural gas afflict the environment with emissions of sulfur dioxide, nitrogen oxides, dust, and a noxious mixture of organic compounds. They generate a great deal of the carbon dioxide that contributes to global warming. Nuclear power plants eliminate the carbon dioxide problem -- but only through a Faustian exchange with the intractable problems of radioactive contamination.

Pollution prevention calls for a transformation in the technology of power production. It leads us, for example, to a source of electricity that generates neither carbon dioxide, noxious air pollutants, nor radioactivity -- photovoltaic cells. What stands in the way of adopting this ecologically sound, clean technology is its price. Photovoltaic cells and their auxiliary equipment, such as batteries, are still too costly to compete in the major market for utility electricity. Photovoltaic cell production is already well developed, and the small industry that now exists, chiefly in the United States and Japan, is reliably supplying photovoltaic cells for portable electronic appliances

and remote installations -- applications that do not compete with electric utilities.

Yet there is little motion toward large-scale application of photovoltaic cells as a means of reducing the severe environmental impact of the present, massive production of power from fossil fuels and nuclear reactors. Sharp price reductions could be achieved, and the market increased, by greatly expanding production facilities, with the resultant economies of scale. But at the present price, the demand is small and insufficient to justify the investments needed to expand production.

Here, too, a government procurement program would solve the problem. This is not a new idea. Just such a program was proposed during the Carter Administration, in the form of a bill -- passed by Congress but vetoed by Mr. Carter -- for a $400 million purchase of photovoltaic cells for use in federal installations. (This proposal was based on earlier experience with the impact of large-scale federal procurement of integrated circuit computer chips in the 1950's -- which sharply expanded production and reduced their price by some 95% over a five-year period and thereby created the present computer industry.) It was estimated that a procurement program representing 150 megawatts of power would reduce the then-current price of $20 per peak watt to $0.50 over a five-year period. As the price drops, the market for photovoltaic electricity expands enormously. At $1 per watt, photovoltaic cells become economically feasible for roadside lighting, representing a demand of about 50,000 megawatts. At $0.50 per peak watt, photovoltaic cells were expected to compete with utility power in many parts of the

country. Once again, a federal procurement plan, which could readily be augmented by state and municipal purchases, would generate the demand needed to bring this pollution-preventing, environmentally clean production technology into the market.

Recycling is a major feature of pollution prevention, for by keeping materials in their separate, useful state, it prevents the generation of trash. A major obstacle to large-scale recycling, which, as a recent CBNS test has demonstrated, can dispose of as much as 84% of household trash, is the lack of markets. This difficulty in turn is largely due to the potential users' reluctance to make the necessary investments in process modifications. All this could change almost overnight if the federal (and other) governments would simply decide to buy only recycled paper.

How could the strategy of pollution prevention be applied to the pervasive environmental problems generated by the heavy use of synthetic pesticides and chemical nitrogen fertilizers in agriculture? To prevent the resultant environmental impact, which leads to pollution of groundwater and water supplies -- and, all too frequently, to food unacceptably contaminated with toxic pesticide residues -- the technology of agricultural production must be changed. The heavy application of chemical nitrogen fertilizer must give way to natural sources -- nitrogen-fixing plants and organic forms of soil nitrogen -- and pests must be controlled by their natural predators instead of by synthetic chemicals. We now know from a recent National Research Council/National Academy of Sciences report that this is both

technically and economically feasible. This confirms a much earlier CBNS study that showed from a detailed comparison of a group of large-scale Midwestern farms with otherwise similar, conventional, ones that organic farms produce only 8.5% less output but achieve exactly the same income per acre.

What stands in the way of transforming U.S. agriculture -- wholesale -- from its present chemically based technology to organic farming? In fact, this transformation is already under way, albeit slowly, for organically grown fruits and vegetables are now in the market, appearing regularly, for example, on the shelves of New York City supermarkets. However, organic food sells at a price premium of as much as 50%. This effectively limits the market to affluent people, separating the food supply into two streams, one free of chemical contamination but available only to the rich, and the other, often contaminated by pesticide residues, but available to the poor.

Apart from the untoward moral consequences of this situation, the small market for organic food prevents economies of scale and perpetuates the high prices that stand in the way of large-scale expansion. A major obstacle is that it may take five years or more after chemical agriculture is stopped for the natural fertility of the soil and the natural balance between pests and predators to be restored -- a period in which the farmer may need federal support. Again, these difficulties could be readily overcome by procuring organic produce for cafeterias and restaurants that serve federal establishments. Imagine the impact of a White House state dinner free of agricultural chemicals and a menu printed on recycled paper.

Thus, we are at a crucial point in the 20-year effort to clean up the environment. We have made a massive attempt to significantly reduce pollution levels with control devices -- and have failed. But we have learned what works: preventing pollution by transforming the production technology that generates the pollutant, to eliminate it. We also know that the necessary clean technologies are largely in hand. Yet this is the only workable way of responding to the insistent public demand for environmental action. We are confronted, therefore, by the intimidating prospect of a radical transformation of the national system of production -- in agriculture, transportation, energy and manufacturing.

Nevertheless, I have demonstrated, I believe -- here, in an earlier account in the EPA Journal, and in more detail in my recent book, Making Peace with the Planet -- that there is a powerful tool, in the hands of federal and state governments and even some municipalities, that can break us out of this impasse: government procurement of the clean technologies.

That we are at a momentous, historic juncture has been recognized by William K. Reilly, the EPA Administrator, who recently said:

> "...The dawning of the third environmental decade finds us at a historic turning-point -- a time when we must find a new approach to meeting our needs...a new approach to managing waste: pollution prevention."

Moreover, in testimony to Congress, Mr. Reilly has cited the importance of using federal procurement programs to develop markets for recycled materials and other products of clean pollution prevention-guided technologies. Finally, the

principles of pollution prevention have been embraced by President Bush himself when, last June, in an address to a Washington environmental group, he declared himself not only an environmentalist but a preventionist as well. And, given the fortuitous timing of Earth Day 1990 -- when the whole world was engrossed with environmental concerns -- there was a marvelous opportunity for Mr. Bush to respond by taking the one step that would begin to put pollution prevention into action: government procurement.

I say all this to explain my enthusiastic reaction to the discovery, shortly before Earth Day, that the EPA had, in fact, moved to turn that event into a truly historic one. EPA had prepared, for Mr. Bush's approval, a Presidential Executive Order, to be announced on Earth Day, that would set in motion a comprehensive federal procurement program, soundly derived from the principles of pollution prevention. The objectives of the proposed order are worth quoting in full, for they reflect a deep understanding of the nature and significance of the new policy:

> WHEREAS, traditional environmental protection approaches which stress treatment and disposal after pollutants have been generated will not be adequate to assure protection of human health and the environment. Pollution prevention and recycling must become the focus of our long-term strategy for environmental protection, and
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> WHEREAS, the Federal government can no longer view energy, transportation, agriculture, and natural resource policies as discrete from the nation's long term environmental protection objectives. These policies must become instruments to achieve the protection of human health and the sustainable development of our resources in an ecologically safe manner, and

> WHEREAS, the Federal government should become a leader in the area of pollution prevention, recycling, and procurement. The Federal government should function as a proving ground for innovative pollution prevention programs and technologies, should build markets for clean products, and should incorporate pollution prevention into the basic daily choices of Federal employees, and
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> WHEREAS, as the single largest consumer in the Nation, the Federal government has the opportunity and the responsibility to move into the forefront of pollution prevention and solid waste management by both reducing the amount of waste that the government produces in the first place, and by recycling as much of the remaining waste as possible.

The executive order calls on "...all Federal Agencies, and Government-owned, contractor operated facilities (GOCOs) [to] reduce the generation of pollutants and waste...and set an example for the rest of society through the development of pollution prevention, recycling and procurement programs... [to] stimulate demand and markets for clean, recyclable and recycled materials by revising procurement policies and specifications."

Section 506(c) of the proposed Executive Order gives the EPA Administrator the authority to take actions that would put the Federal procurement program that I have outlined in place:

> "The Administrator of the Environmental Protection Agency shall...'provide guidance to assist procuring agencies in promoting the purchase of recycled products, clean technologies and products, and products that maximize energy or water efficiency and conservation.'"

Under these terms, "clean technologies and products" would include electric cars and organic foods, and "products that maximize energy or water efficiency and conservation" would include photovoltaic cells.

So, I am happy to report that under Mr. Reilly's leadership,

EPA has devised a program that would put pollution prevention into practice -- an action that could have turned Earth Day 1990 into a truly historic event. Unhappily, I must also report that the proposed Executive Order was killed by the President's Domestic Policy Council.

That President Bush failed to seize this opportunity to endow Earth Day 1990 with the momentous content that it merited -- he went fishing instead -- can be traced, I believe, to his Chief of Staff, Mr. Sununu. In his powerful position, which includes a guiding role in the Domestic Policy Council, Mr. Sununu, often abetted by Richard Darman, Director of the Office of Management and Budget, has a record of environmental obstructionism. Mr. Sununu intervened to overrule EPA and seriously weaken the Administration's position on remedying global warming and ozone depletion, on wetlands protection, and on air pollution legislation. We are told by the White House that Mr. Sununu simply prepares options for the President's consideration and "insures that all points of view are heard." But to my knowledge there is no evidence that the EPA's historic Executive Order ever escaped from the deadly confines of the Domestic Policy Council and reached the President. Perhaps it did, but got lost in his tackle box.

Had Mr. Bush in fact issued the Executive Order proposed by EPA, the country and the world would have been galvanized into action -- but this time, unlike 1970, guided by the only workable environmental strategy: pollution prevention. This would have been a magnificent act of leadership, converting the despair and anguish over the fate of the Earth often voiced by Earth Day

participants into a meaningful movement to restore the natural environment. Earth Day cried out for leadership, and EPA's courageous, far-sighted proposal provided the necessary vehicle. In blocking the EPA proposal, Mr. Sununu deprived Mr. Bush of a historic opportunity to lead. And Earth Day, thereby drained of significant content, became only a brief, if noisy -- but unanswered -- outcry for help.

The obstruction of EPA's Executive Order is not only a blow to the nation's environmental future; it also diminishes the power of American democracy. The demand for real environmental improvement is a national commitment which, as we know, can be realized only by changing the pattern of industrial investment. But these decisions are in private, largely corporate hands, and inaccessible -- thus far -- to the American people. Democracy stops at the door to the corporate boardroom.

The government's massive purchasing power is the only means, at present, of influencing the pervasive corporate decisions that now govern our system of production. This power is an important instrument of American democracy. For the sake of the environment and of democracy itself, it is time that we used it.